Space Weather Technical Forecast

Issued on Friday, 07 April 2023 at 00:30 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares (R1-R2; Minor-Moderate radio blackouts) throughout. Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with AR3272, a newly emerged region close to the southeast limb, producing an isolated M3 flare, peaking at 06/0553 UTC. There are three other sunspot regions on the visible disc. AR3270 is currently the largest and most complex region fully on the disc, and previously exhibited a delta spot in the intermediate spots which has since faded. However, given that the new region rotating onto the southeast limb has already produced an M-flare, this suggests greater complexity than can currently be accurately assessed. The other spots are relatively small and simple.

No Earth directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind as observed by DSCOVR at L1 has been at largely at slow-ambient levels around 380 km/s, with brief periods of slightly elevated winds. Around 06/1930 UTC winds increased to 410 km/s and have since remained slightly elevated. Density has fluctuated between average to slightly below. Magnetic field strength, Bt, has been weak throughout, below 7 nT. The north-south component, Bz, varied weakly between +/-6 nT. The Phi angle has been mostly negative (towards the Sun). Geomagnetic activity has been Quiet to Unsettled.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as measured at GOES16, has been at background levels. The high energy electron flux (greater than 2MeV), as measured at GOES16, crossed the threshold to high levels at 06/1020 UTC and at the diurnal maximum period reached a peak of 4250 pfu at 06/17205 UTC, it is currently on a downwards trajectory and returned to moderate levels around 06/2320 UTC. Electron fluence climbed very slightly to reach the Active threshold by 06/0900 UTC and has since remained Active, with 1.29e8 integrated pfu recorded at 07/0001 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is most likely to be Low, but with a chance of Moderate activity, either from AR3270 in the southwest, or AR3272, the emerging region in the southeast. Other regions may emerge across the northeastern limb during the period to add complexity to the forecast.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs expected. Wind speeds are likely to fluctuate between slow-ambient and slightly elevated levels. In the absence of any CMEs, wind speeds are expected to remain at or near this level for much of Days 1-3 (07-09 Apr). CH91/+ may start to show some HSS influence by the end of Day 3, but this is more likely to occur on Day 4 (10 Apr).

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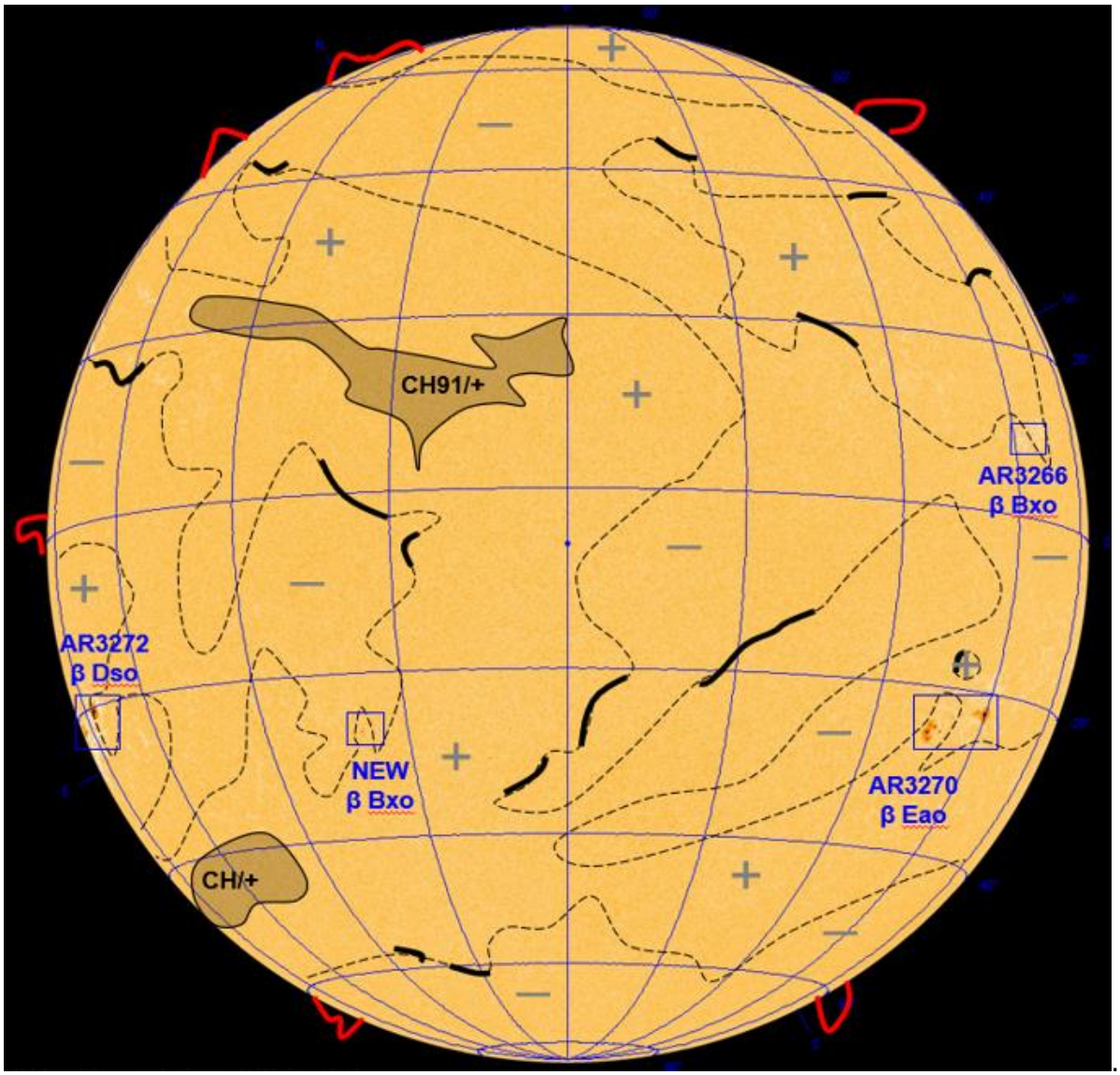
Geomagnetic activity is expected to be Quiet to Unsettled, with a chance of Active periods from late Day 3 and through Day 4 if we do see a connection to the HSS.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) is at background levels and is likely to remain so, in the absence of significant flare activity. Electron flux values are likely to continue to show a diurnal cycle between moderate and high levels. Potentially higher energy electron density at lower orbits could result in an increase in electron flux values. Electron fluence is likely to be at or close to the Active (1e8 integrated pfu) threshold, perhaps increasing slightly through the period.

Figure 1. Solar Analysis Valid 06/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are currently no Earth-directed CMEs expected. However, one CME towards the southeast limb has recently presented on LASCO imagery and is yet to be analysed.
The recent HSS from either coronal holes 89 or 90 has now faded, with wind speeds fluctuating between slow-ambient and slightly elevated levels. In the absence of any CMEs, wind speeds are expected to remain at or near this level for much of Days 1-3 (07-09 Apr).

A high speed stream (HSS) from CH91/+ is expected to influence the wind regime by Day 4 (10 Apr), however, the onset of HSS influence may commence late on Day 3. The leading edge of the coronal hole appears to be a little further ahead this time when compared to the previous rotation suggesting the possibility of the slightly earlier arrival on Day 3. This coronal hole is positive, which is not favoured for a strong connection nor geomagnetic response close to the March equinox.

Geomagnetic activity is expected to be Quiet to Unsettled, with a chance of Active periods from late Day 3 and through Day 4 if we do see a connection to the HSS. There is an associated very slight increase in the probability of a Minor Geomagnetic Storm/G1 interval for this same period.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	5	10	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil expected.

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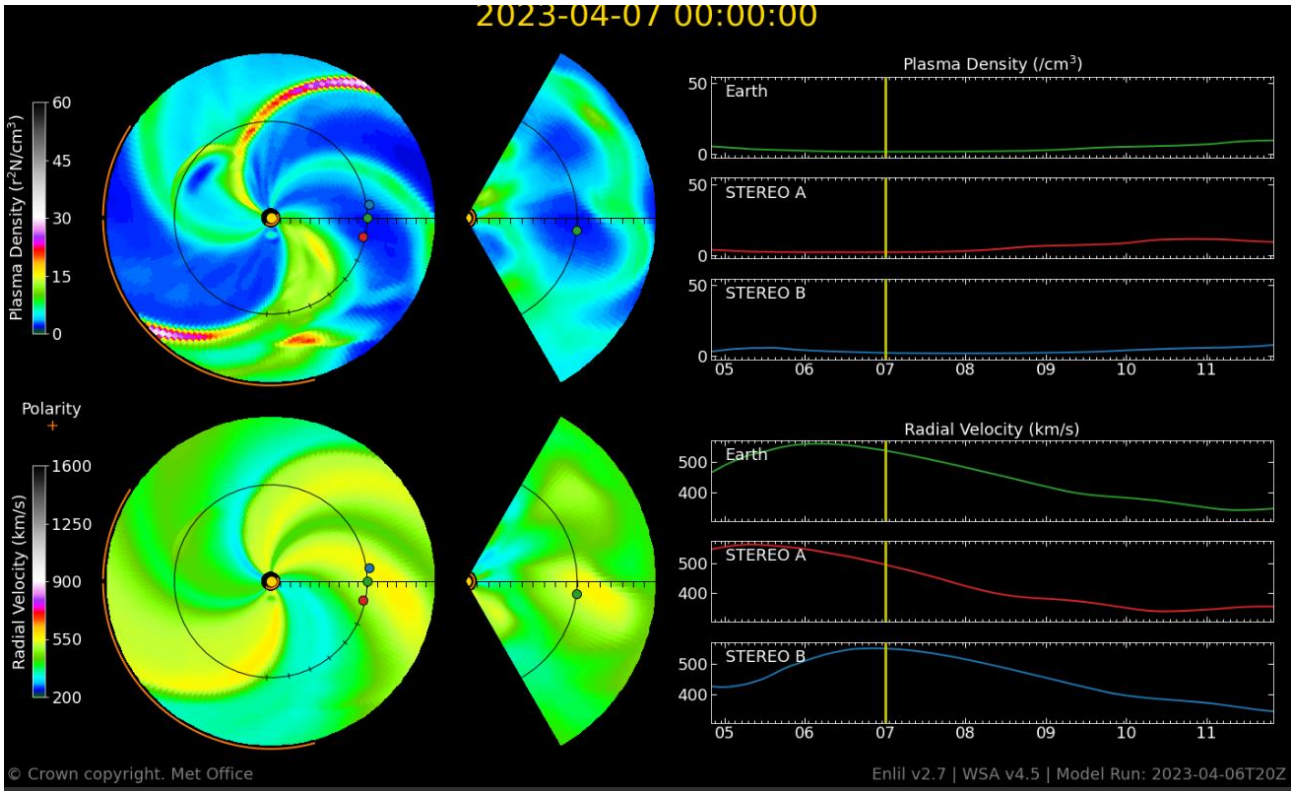
Figure 2: MOSWOC Enlil – currently considered to be offering poor guidance. Still showing influence from now waned HSS and indicates wind speeds around 150 km/s too high initially. Potential HSS from CH91/+ also absent later in period, with speeds likely 150-200 km/s too low.



Radio Blackouts - X-Ray Flares:
Solar activity has been Moderate, with AR3272, a newly emerged region close to the southeast limb, producing an isolated M3 flare, which peaked at 06/0553 UTC. Activity is most likely to remain Low through the forecast period, although there is a chance of further M-class flares through the period, most likely emanating from AR3272 as it rotates further onto the visible disc.

There are three numbered sunspots currently on the visible disc, and one recently emerged unnumbered region in the southeast of the disc.
AR3270 is currently the largest and most complex region fully on the visible disc, and previously exhibited a delta spot in the intermediate spots which has since faded. There has been filament disruption in the vicinity of this region, and an increase in magnetic complexity cannot be ruled out.

However, given that region AR3272 rotating onto the southeast limb has already given an M-flare, this suggests greater complexity than can currently be seen on available imagery. The classification is likely to be revised as it rotates further onto the disc and gives us a clearer view.

The other sunspot regions are relatively small and simple, with AR3266 expected to rotate off of the visible disc during Day 1 (07 Apr).

A bright region visible on STEREO-EUVI/195 imagery suggests that a new or returning region may emerge across the northeastern limb and onto the visible disc during the period.

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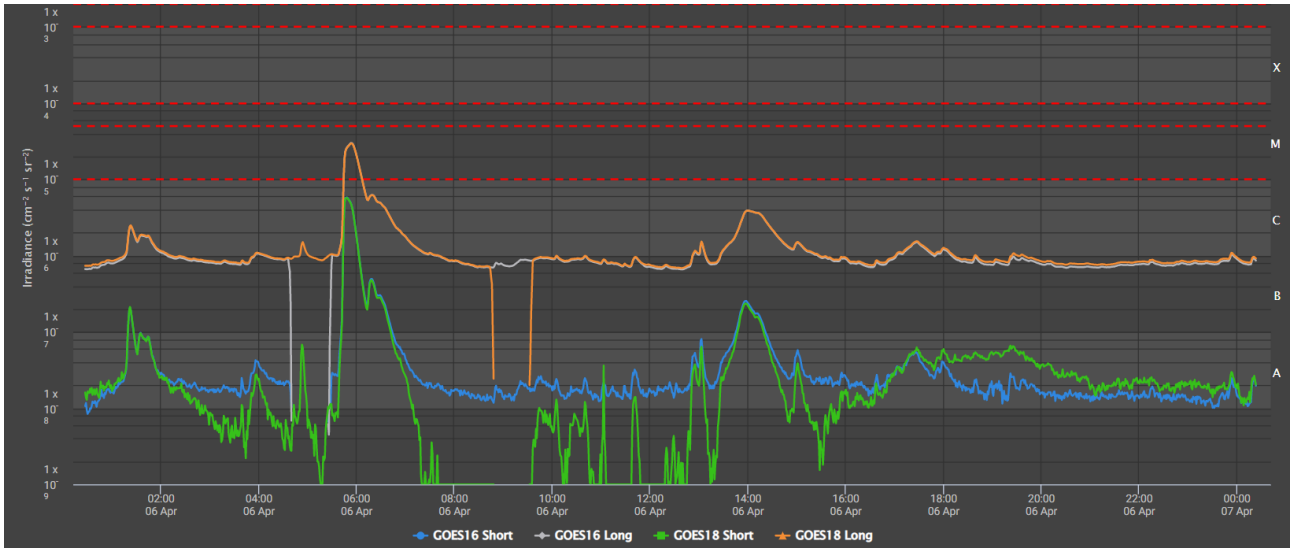
X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	25	25	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES X-ray flare trace showing the M3 flare from AR3272.



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES-16, is most likely to remain at background levels pending any significant sunspot development. There is an extremely slight chance of protons reaching the S1 level, most likely from AR3270 which is in a good position to connect with Earth should a larger flare occur from this region. AR2372, the region towards the southeast limb cannot yet be accurately assessed, but is unlikely to give a proton response at Earth from its current location during this period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	3	3	3	3
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) is forecast to diurnally oscillate between moderate and high (1000 pfu) levels through much of the forecast period. As the solar wind has now recently eased, the pressure on the radiation belt will also ease allowing it to relax towards GEO. The British Antarctic Survey Radiation Belt Model (BAS-RBM) is currently suggesting higher energy electron density at lower orbits, which could then give an increase in electron flux at GEO through Days 1-2 (07-08 Apr) as the belt continues to relax.

Electron fluence reached the Active threshold by 06/0900 UTC where it has since remained. It seems likely that fluence will remain at or near the Active threshold through much of the forecast period, with the possibility of a rise through Days 1-2 if there is increased electron density at lower orbits as described above. Conversely, MOSWOC REFM is suggesting a decline through the forecast period, which, although leads to some uncertainty in this forecast, is not the preferred solution.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	70	60	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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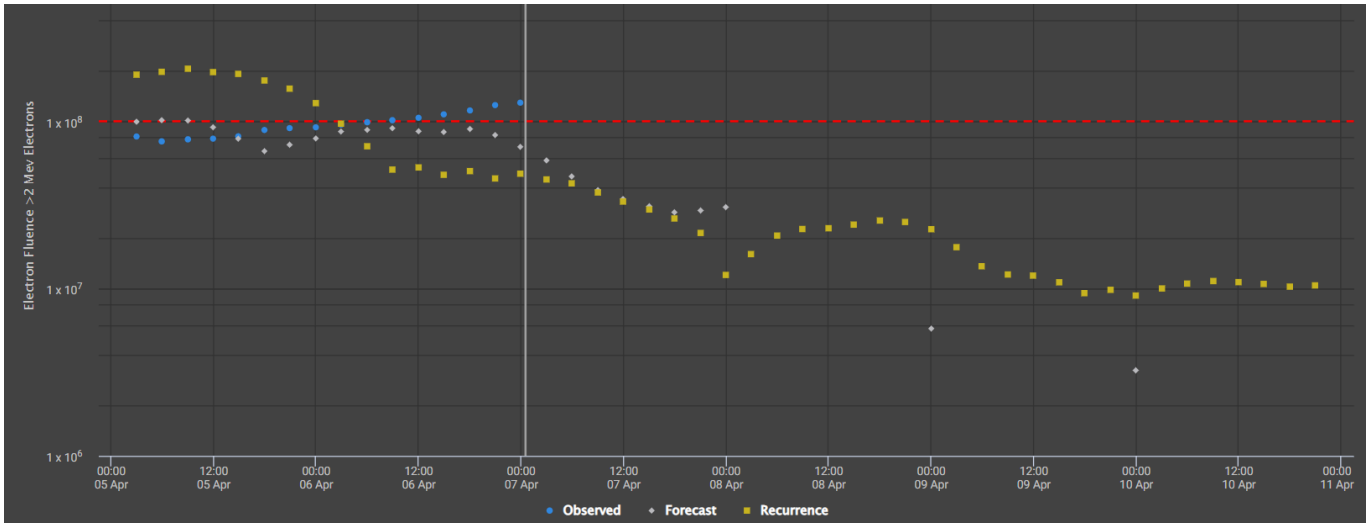
Figure 4: MOSWOC REFM suggesting a downward trend in fluence. However, it currently seems more likely that fluence will remain near or above the Active (1e8 integrated pfu) threshold.



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